

Power Management and Control of Multi-Input Multi-Output Renewable Energy System Using ANFIS Controller

K. Kiran Kumar, P. Sai Sandeep

Abstract: One of the imperative goals in the electrical system is to enhance the utilization of renewable energy sources due to environmental conditions. Since non-conventional energy sources are incorporated into the electrical system, reducing the utilization of conventional energy source. Nowadays, several researchers have been focused on the deficit of resources so if to creating awareness on the renewable energy sources. In the electrical system, the power management system is momentous to obtain the maximum amount of output power from multi-input and multi-output renewable energy systems. Therefore, this paper concentrated on designing of adaptive neuro-fuzzy controller (ANFIS) controller in multi-input and multi-output power management system of small scale electrical systems and to get the better achievement of utilization of electrical energy from renewable energy systems. The ANFIS having adaptability nature, due to that it reduces error value near to zero. Therefore the efficiency of the system is increases and losses are reduces, these are enhances the system performance to greater extent. The simulation has been carried out by Matlab/Simulink along with the response of the system is compared with conventional and fuzzy logic controllers in the presence of power flow, voltage and frequency.

Index Terms: renewable energy sources, distributed power generation, ANFIS controller, multi input and multi-output management, energy systems, conventional energy sources.

I. INTRODUCTION

Recently, the renewable energy sources are performs a crucial role in electrical system. The governments of all countries are motivate the usage of non conventional source along with contribute the benefits to customers. Nowadays, the main task of the worlds is to increase the utilization of renewable energy sources and reduce the usage of conventional energy sources. Besides, conventional sources are quite limited and it has polluted the environmental conditions. In every country, households and medium industrial would prefer to use economical renewable energy technologies as well as conduct the awareness on technologies of non conventional sources by their officials. As know, the fabulous renewable energy is solar in electrical system to produce require amount of electricity. Although having the plenty of opportunities in electrical system by using solar energy, it has some drawbacks such as solar irradiance and temperature conditions[1,2]. In this regard, the grid is preferred as energy system in electrical system.

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In this paper, small scale industrials and household consumers are used the renewable energy systems but in this system would use the separate energy storage system than as grid stored system. The intend of the micro and smart grid are to generate the high amount of electricity through renewable energy sources locally[3]. The advantage of distributed generation systems is to transmit the power merely simple in local areas. It has clean and pollution free energy sources.

II. SYSTEM DESIGN

The In this paper, the main objective is to design and simulate the power management system with control approaches at large load conditions. The difficult task of distributed generation power system is to maintain the output power flow without any disturbance. The converters are protecting the AC and DC bus and to keep the equal the generation and load demand[4].

Different types of incredible controllers are used to produce the huge amount of electrical power and to enhance the local utilization by using renewable energy sources. The control schemes are capable to sustain the online local energy equilibrium when accumulate the data from various subsystems and output signals[5]. In small scale electrical system, different types of conventional controllers and fuzzy controllers are used in multi-input; multi-output systems[6]. The Fig.1 illustrates the power management system with different sources,

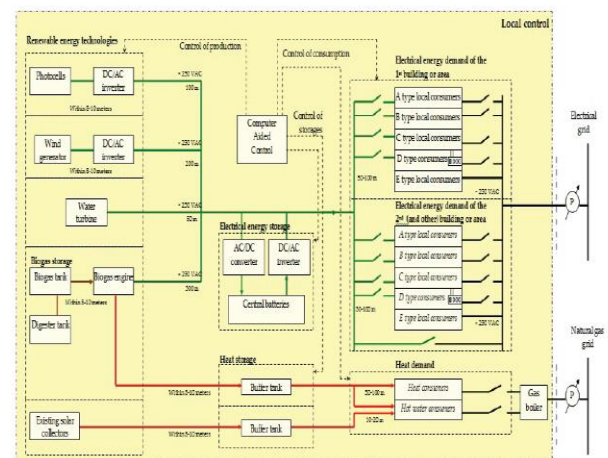


Fig.1 Power management system with different energy sources.

In this paper, artificial fuzzy-neuro inference system (ANFIS) controller is proposed to



minimize the non-linear problems and achieve the better dynamic response against solar irradiance and weather changing conditions.

III. ADAPTIVENEURO-FUZZY CONTROLLER (ANFIS):

One of the important control techniques among soft computing methods is Fuzzy logic controller. Though conventional controller is used in system, it has not regulated the power flow in between the generation and load when system becomes extensive network. So, intelligent controllers are designed to achieve better dynamic performance[7]. Likewise, fuzzy logic system works as if human brain stimulation and commands. The fewer prices of devices are required to operate the fuzzy logic controller and simply interpret the expert knowledge system. The toughest and time consuming process is to create the rules in the fuzzy system for operation of the system[8]. However, fuzzy controller works quite efficient and offered better performances in small scale application like washing machine and power control at water power plant rather than conventional controllers.

On the other hand, the neural network is implemented to solve the non linear problems in electrical power system. It has made up with artificial neurons and connecting one to another in the form of network. Since the neural network is incorporated to the system, it is demonstrated the better dynamic response and easily control the power flow between the areas over fuzzy logic control[9,10]. However, the neural network needs more training to operate as if human brain working.

In this paper, proposed the integration of fuzzy and artificial neural network for control the power flow and keep the nominal voltage and frequency. ANFIS performs significant role in power management system with integration of renewable energy technologies[11,12]. The ANFIS controller illustrates the efficient dynamic performance and power flow controlling rather than conventional, fuzzy and neuro controller.

IV. SIMULATION RESULT ANALYSIS

A. Case 1

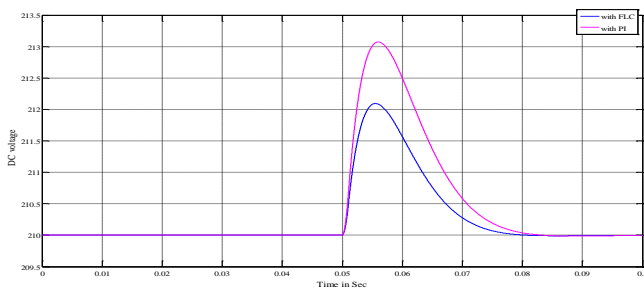


Fig. DC Voltage in case 1

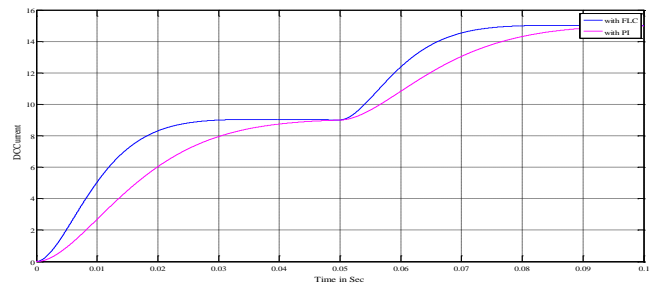


Fig. DC Current in case 1

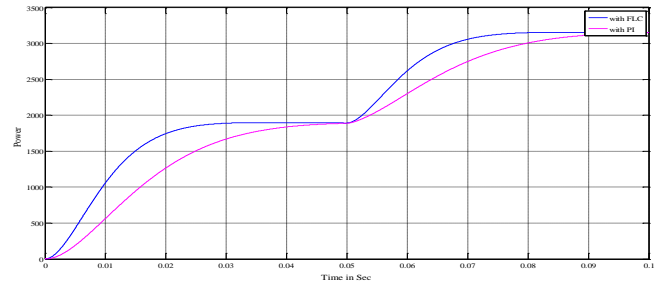


FIG. POWER IN CASE 1

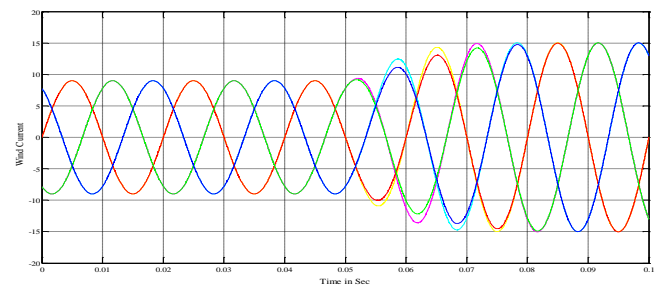
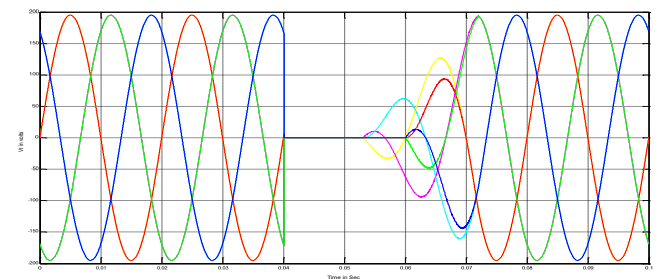


Fig. Wind generator current in case 1



B. Case 2

Fig. Terminal voltage in case 2

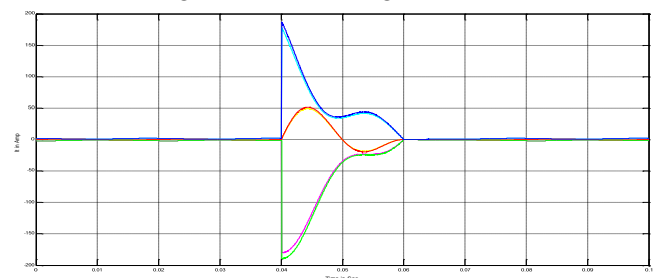


Fig. Terminal Current in case 2

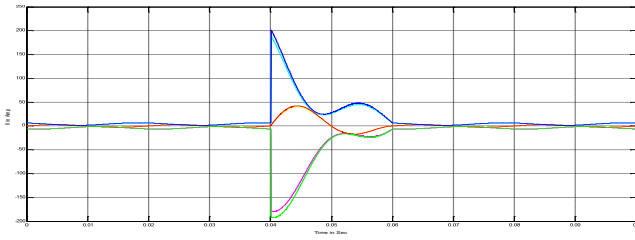


Fig. Load Current in case 2

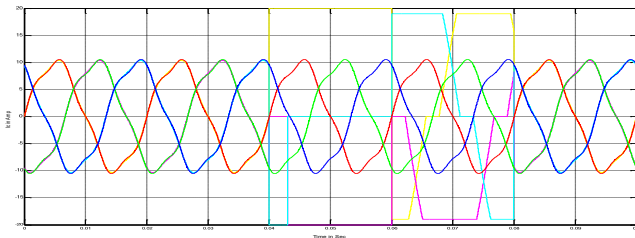


Fig. Capacitor Current in case 2

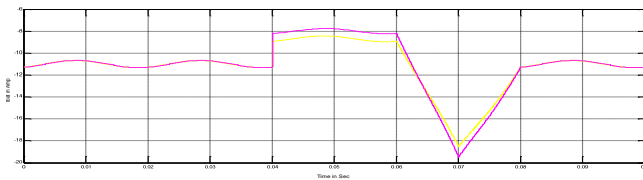


Fig. Battery Current in case 2

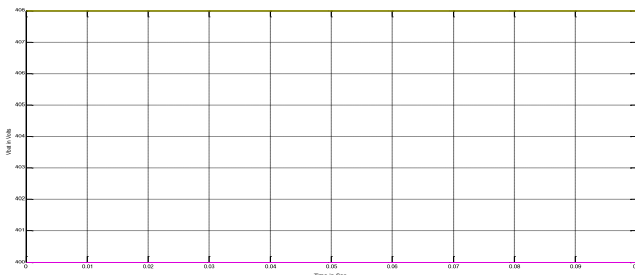


Fig. Battery voltage in case 2

V. CONCLUSION

The adaptive neuro-fuzzy controller has shown the better steady state and transient response along with regulated the power flow between the converters in multi-input and multi-output renewable energy systems in small scale electrical utilization systems. Moreover, the ANFIS control performance compared with other conventional, fuzzy and neuro controllers. Thereupon, ANFIS has performed very well in renewable energy system and retained the voltage and frequency level within scheduled values at different conditions of loading. These control schemes are extended to medium scale electrical power systems.

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